Effects of Water Depth Workshop

BSEE
Bureau of Safety and Environmental Enforcement

Session 5 Overview
Post Incident Containment & Well Control

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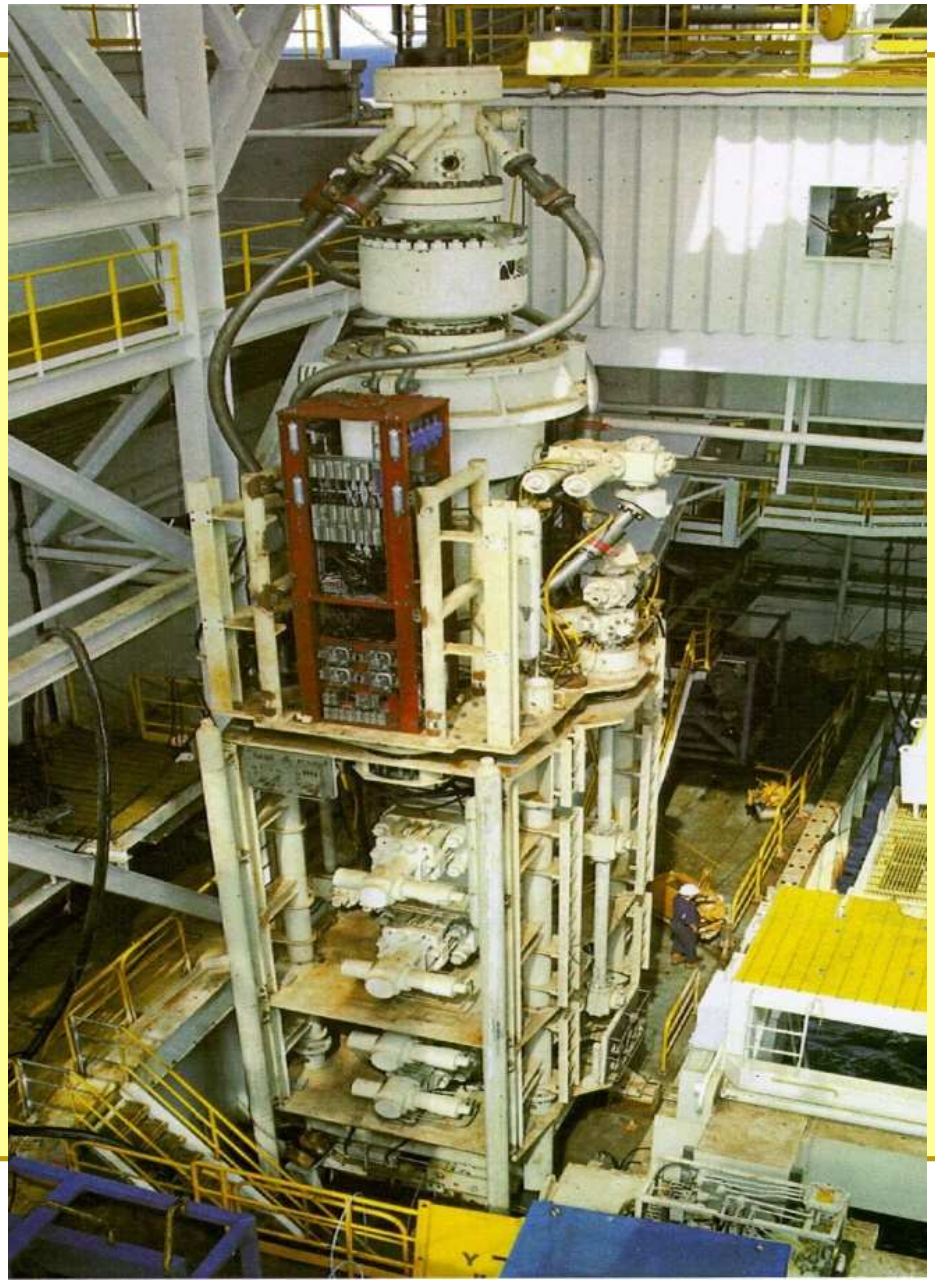
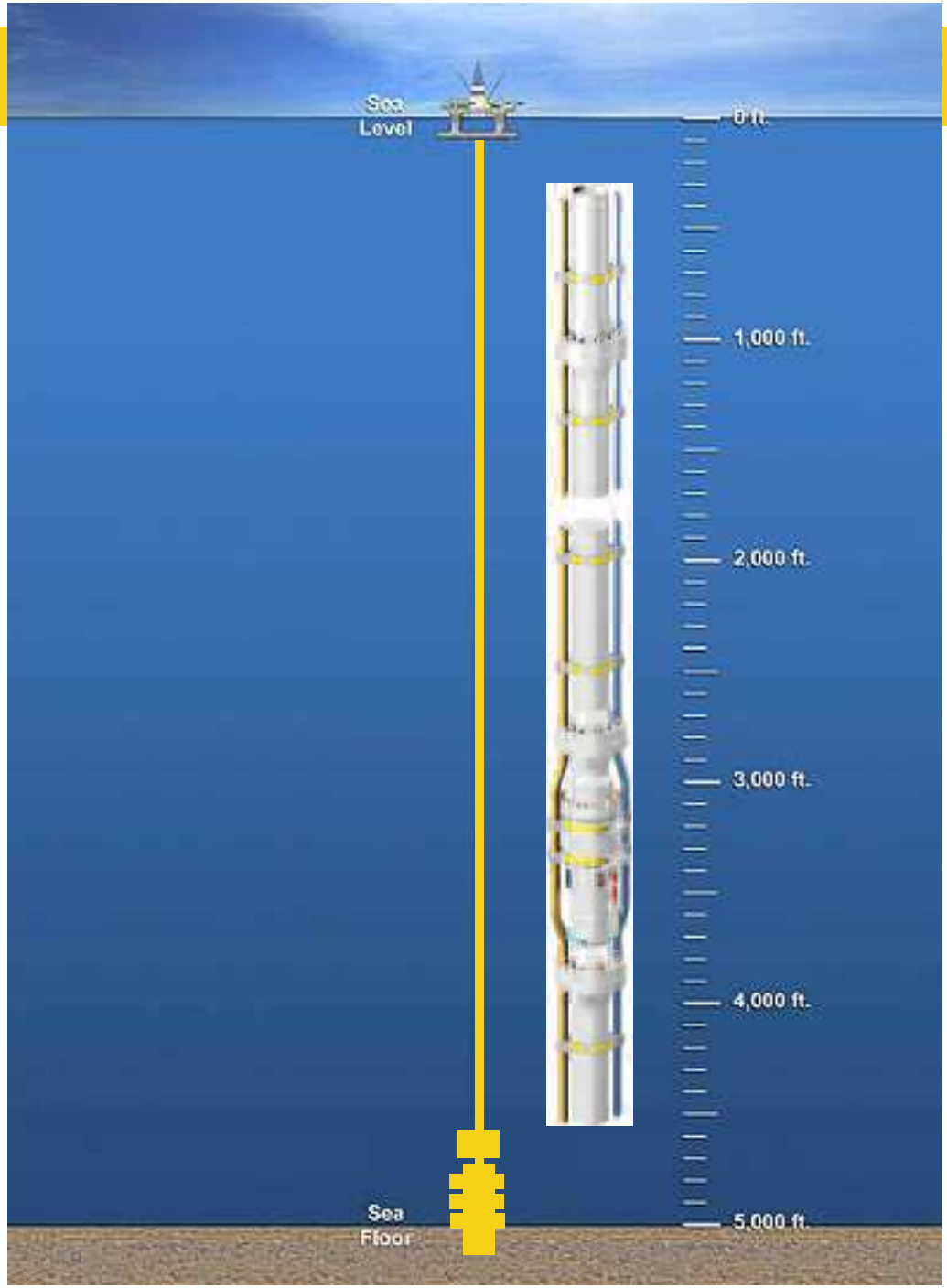
Subsea BOP's & Disconnects

GOM Deepwater Drilling **BOP Systems**

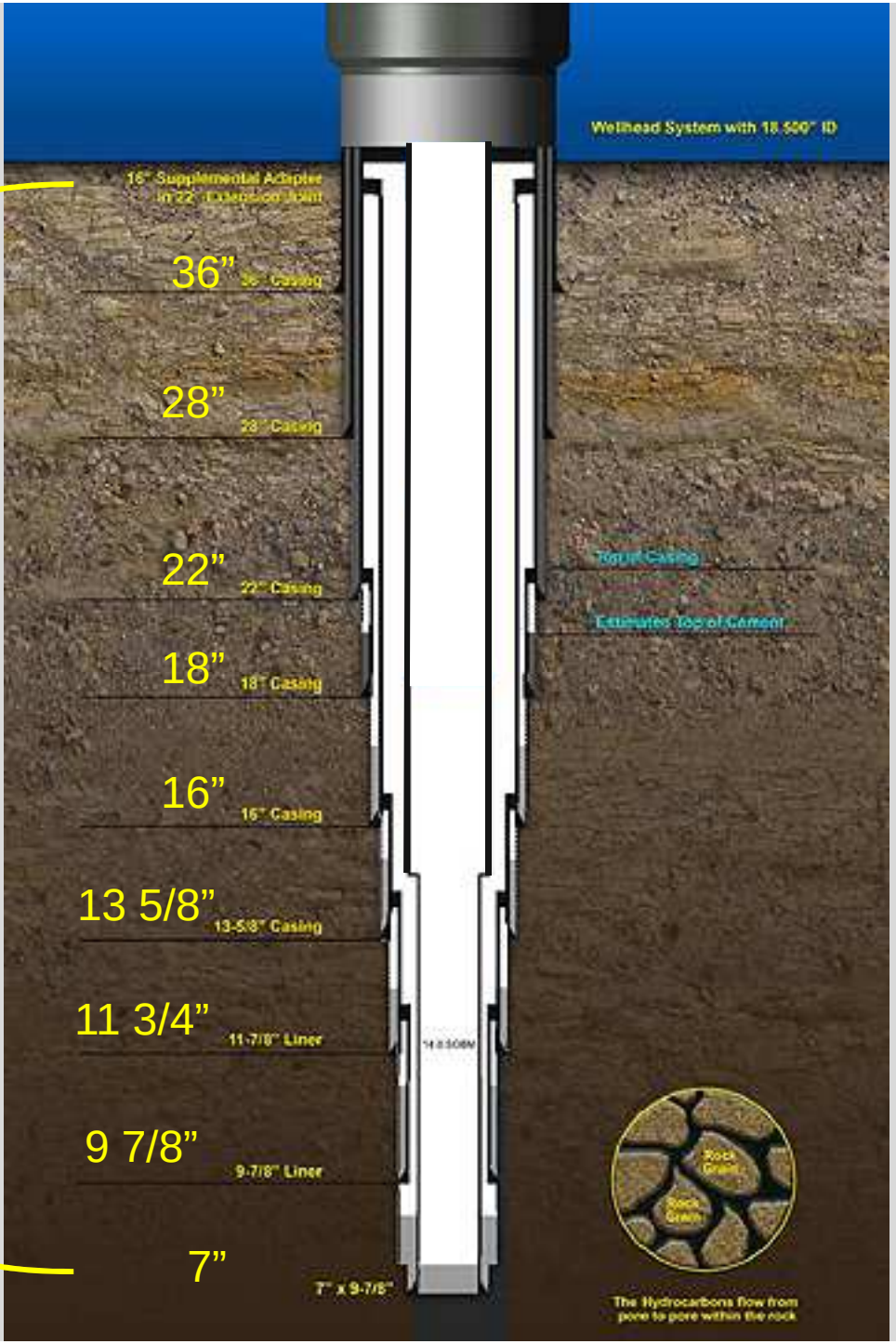


DW Riser & BOP Stack

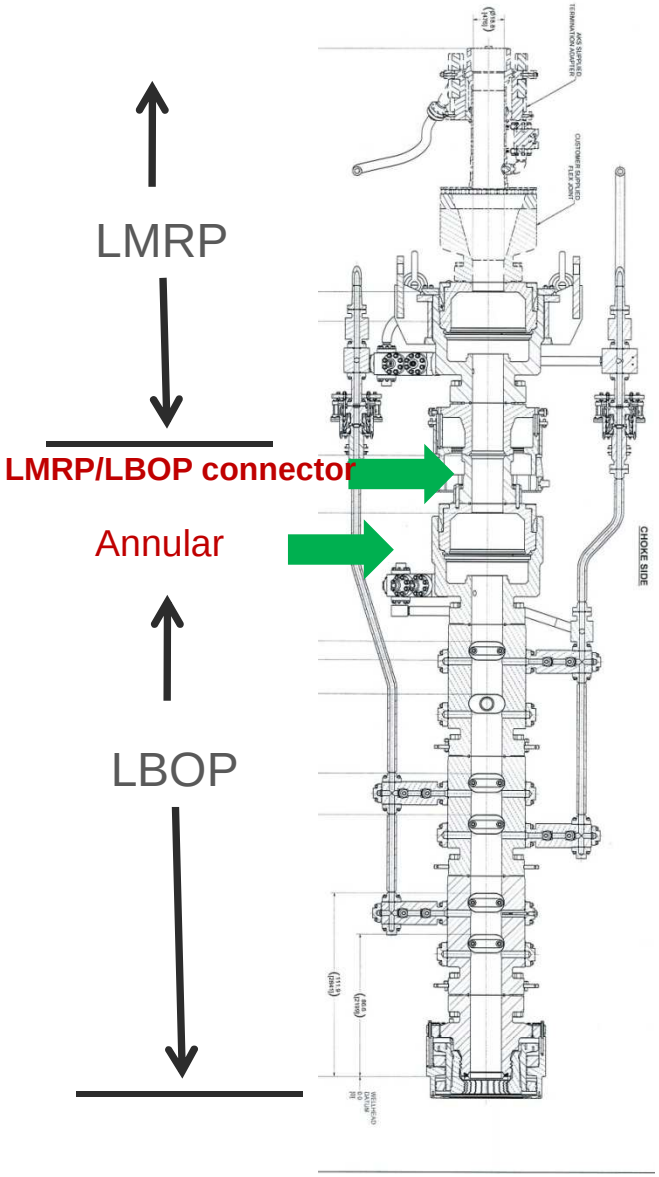


The Well is Drilled to TD = Total Depth

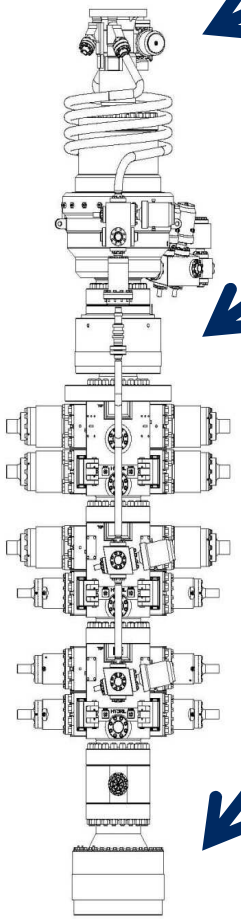
Depending on how fast Pressure Increases……it may take numerous casing strings to reach TD.



Subsea BOP



Typical Attachment Points – Subsea BOP



BOP STACK
SAMPLE DRAWING
FOR REFERENCE ONLY

Riser Adapter

- Located above lower flex joint in LMRP
- ~ 5000 psi rating
- ***NOT RECOMMENDED***, retain as ***contingency***

LBOP Mandrel

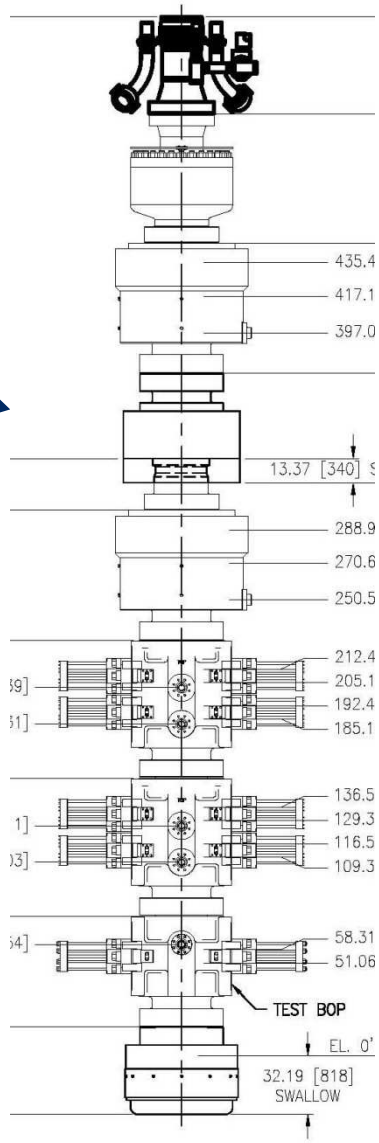
- Located at upper portion of Lower BOP
- Interface to LMRP connector
- Vetco H4 or Cameron mandrel are most common
- 10 ksi or 15 ksi (BOP-specific)
- ***PRIMARY INTERFACE***

SS Wellhead

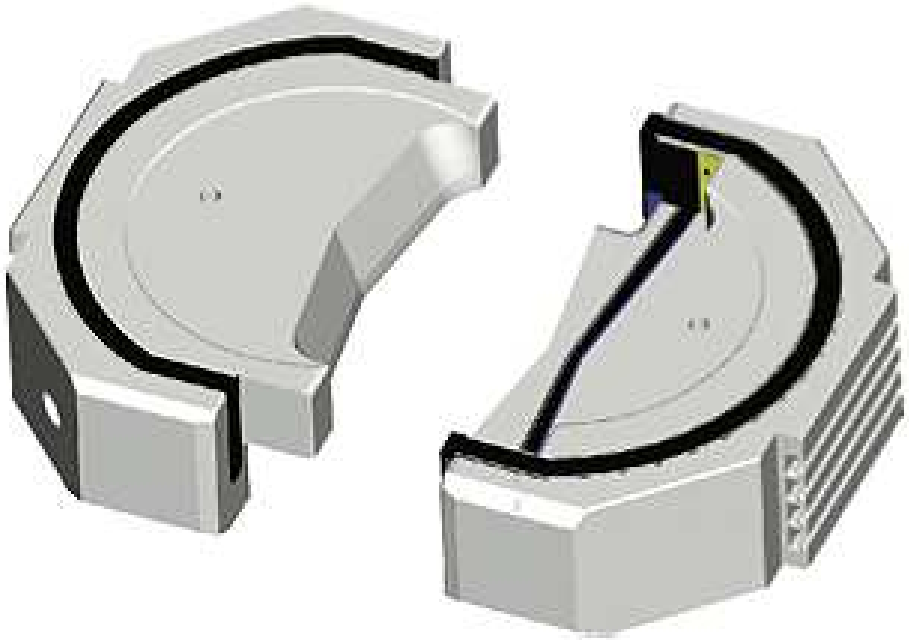
- BOP to wellhead connector
- H4 27” mandrel and SHDH4 31” OD mandrel are most common
- ***SECONDARY INTERFACE***

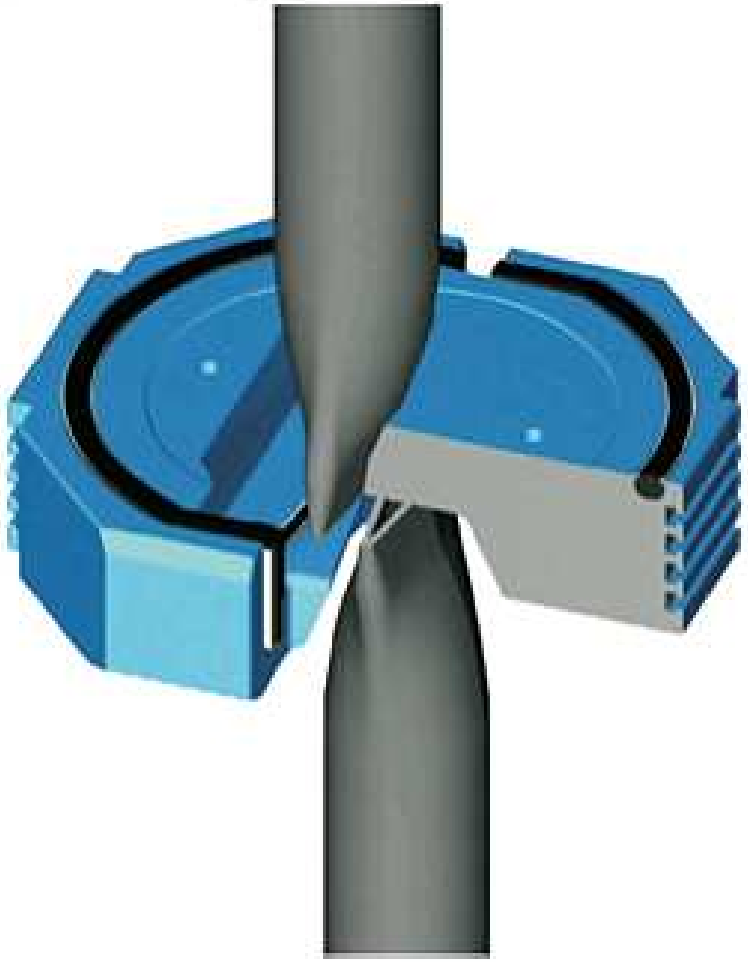
NOTES:

1. BOP configurations vary
2. BOP framing not shown



Blow Out Preventer (BOP) Shear Rams



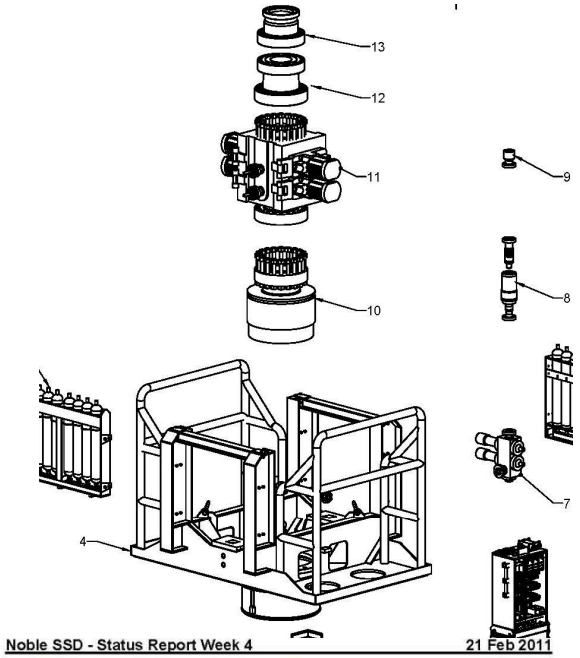


Subsea Containment Systems & Capping Stacks Consist of Normal Subsea Components that are Designed Built and Installed Everyday in Deepwater

Capping Stacks

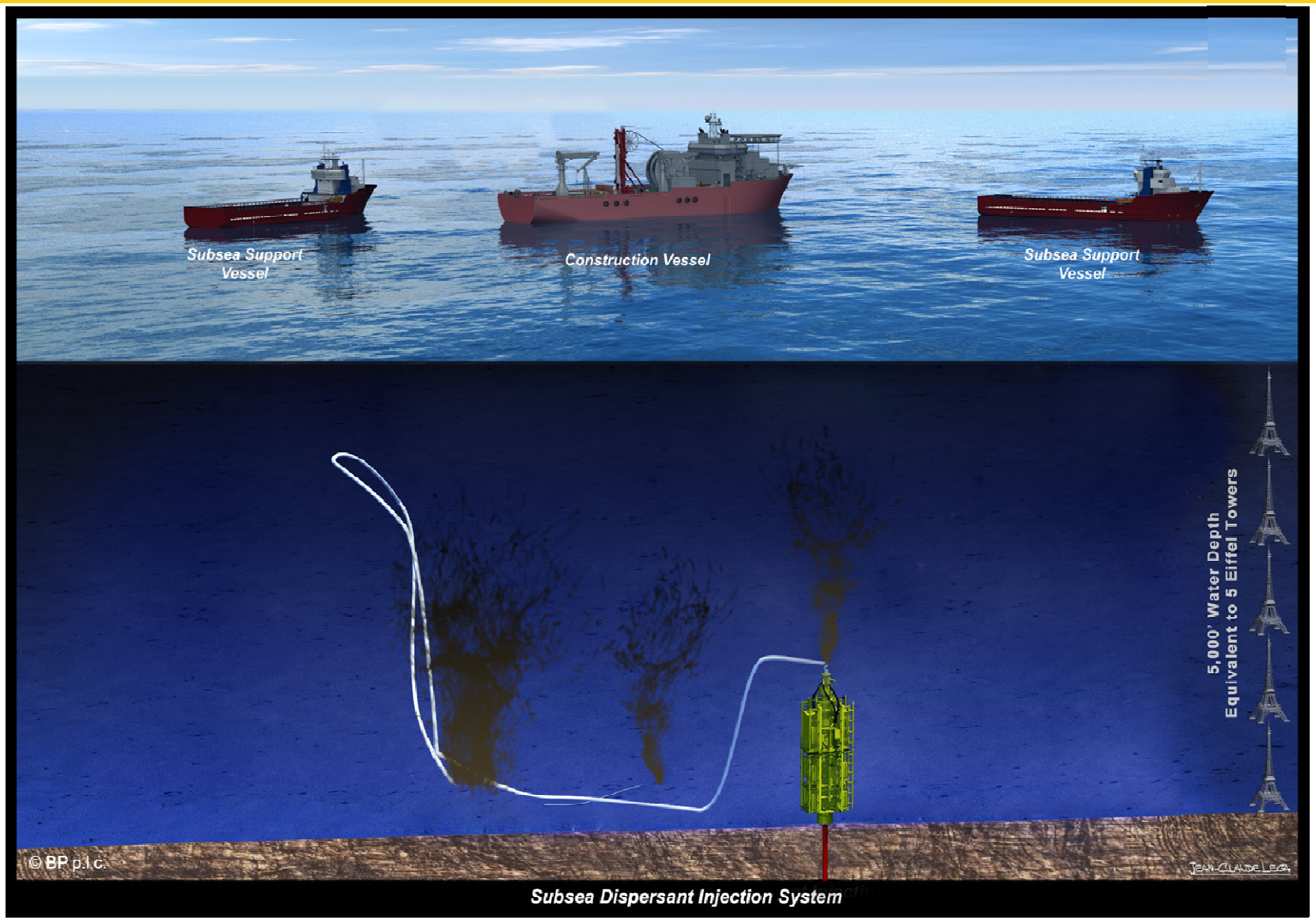
Capping Stack

- System Summary
  - 15 ksi system; 10,000’ water depth
  - Functions:
    - BOP connector,
    - 2x blind/shear rams,
    - 2x valves + inlet below BSR;
    - connector profile on top
  - Controls: ROV panel, SS accumulator bottles
  - Weight: 130 Tons
  - Connector options
    - Vetco H4
    - Cameron HC

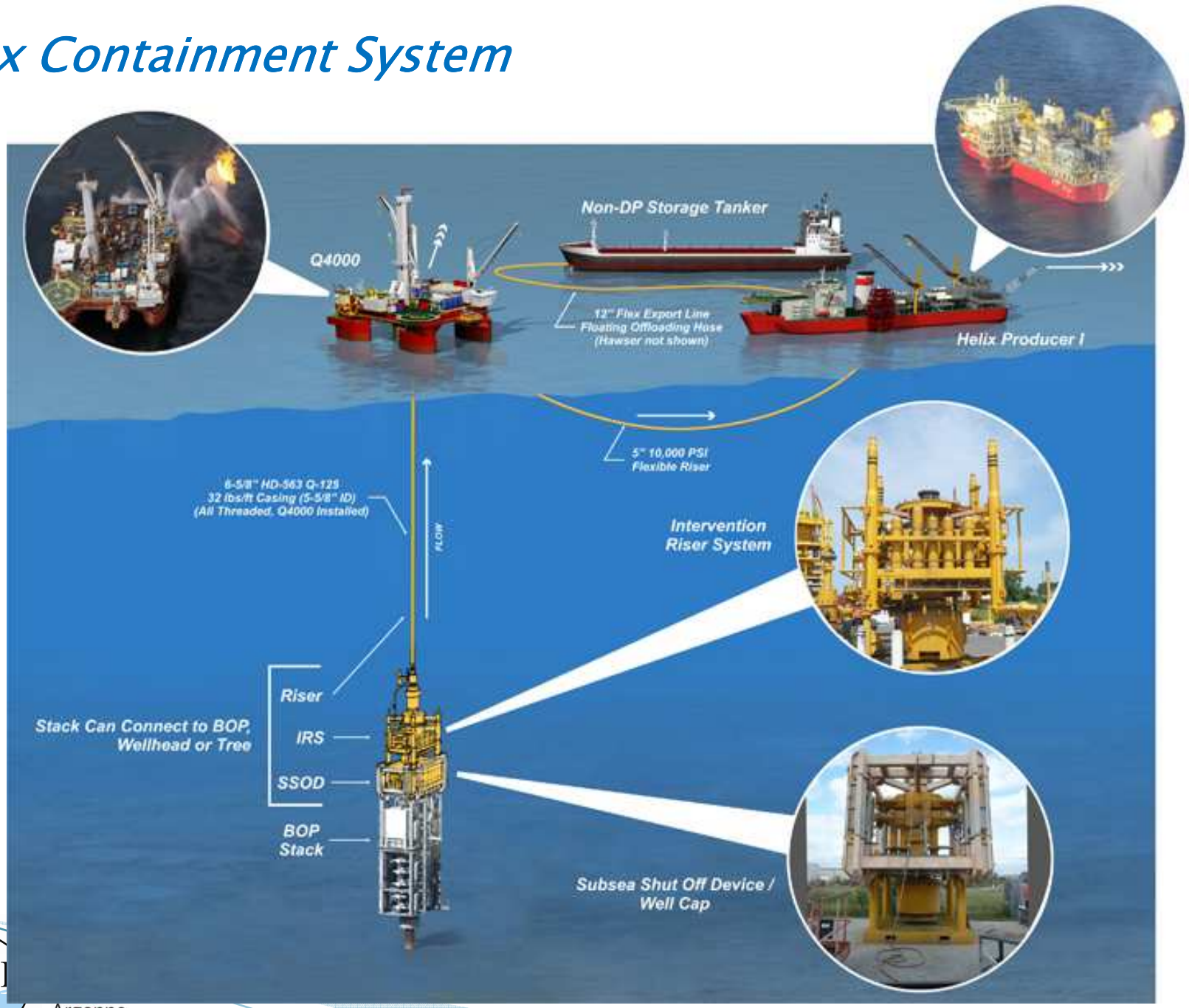


Subsea Containment System
&
Deployment Sequence

Subsea BOP on Sea Floor



Helix Containment System



Subsea Well Control & Containment Task Force

Sub Groups

- Well Containment at the Seafloor
  - Sealing Connection to the Well or Seafloor
  - Top Kill Procedures & Methods
  - Existing Equipment Modification
- Intervention and Containment Within the Subsea Well
  - Relief Wells
  - Dynamic Kill
  - Direct Mechanical Intervention inside the Well
    - Subsea Snubbing; Coil Tubing; Packers/Mechanical Barriers; Reactant Pills
- Subsea Collection and Surface Processing & Storage
  - Well Production Capture Systems
    - With Sealing to the Well
    - With No Sealing directly to Well
    - Dispersed Flow from the seafloor

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Subsea Well Control & Containment Task Force

59 Members from Industry
Identified 29 recommendations, including 15 immediate action items

Remaining Actions

- LMRP release methods
- Sealing on Damaged Connections
- Enhanced ROV actuation & control
- Wellhead structure & foundation
- Additional BOP connection points

RP Documentation for Containment

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- NTL-2010-N10 – 8 November 2010

  - Statement of Compliance with Applicable Regulations
  - Demonstrating Spill Response & Well Containment Resources

  - Containment Options:

    (all to have a top-hat + dispersant + hydrate control)

- Full shut-in and containment of the well via well capping
- Shut-in of the well with subsurface pressure relief that will not broach the seafloor
- Containment of the well within a system that allows flow to the surface until a relief well can be drilled

Containment

- Documentation:
  - Well Design Sheet
  - Flow Schematic
  - Functional Specification of Containment Equipment
  - Responsible Party Check-list
  - "Nodal" Analysis
  - Contractual Agreements

- What is the impact of water depth on each of the functions or operations?

The process and equipment components for subsea containment and well capping are the same regardless of water depth in DW.

Technical challenges that increase with water depth:

- Hydrates
- Intervention vessels and equipment must have adequate depth rating
- Motive force - Pressurized hydraulic fluids

Benefits to the increasing water depth:

- The increased hydrostatic head
- Dispersants effectiveness

Tech Challenges in Shallow water:

Generally this equipment cannot be used in less than 500 feet of water.

- Visibility
- Direct vertical intervention impossible
- High concentration of hydrocarbons especially gas (limited hydrostatic)
- Dynamic positioning not possible
- Risers difficult

- **What are the most challenging functions and operations?**

1.Debris Removal
2.SIMOPS
3.Weather & Current
4.Weight & Size of Capping Stacks
5.Lack of well integrity data

In which of these areas is the Industry quickly advancing and adapting?

- **Subsea containment systems and equipment.**
- **Well designs to allow full cap and shut-in even with annular pressure build-up under worst case discharge (WCD)**
- **Sharing of capabilities & best practices between Operators**

B) Trends and/or notable technologies envisioned for the near & long-term

- **Water Depth**
- **Increasing Pressure & Temperature**
- **More rapid deployment**
- **Deployment under production Structures**
- **Disconnect at the Riser**
- **In well shut-in devices & supplemental shearing**
- **Instrumented BOP's**
- **Well integrity determination**

C) Coordination & communication to align the efforts of industry & regulatory agencies

1)Current Alignment Mechanisms

- API
- Federal Advisory Committee (Ocean Energy Safety Advisory Committee)
- Conferences, Forums and Workshops
- Industry Trade Associations
- Offshore Operators Committee (OOC)
- Petroleum Equipment Suppliers Association (PESA)

2)Improved Relationships

Are there opportunities for improvement in the relationship between operators, drilling contractors, third party suppliers, manufacturers and regulatory bodies?

- **SEMS, HSE Case, & Bridging Documents**
- **Regulator / Industry Collaboration**
- **Center for Offshore Safety**
- **Containment Organizations**

E) Human Factors in Safety (e.g. training, procedures)

- **SEMS**
- **Responsible Party Check-list**
- **Drills, Deployments, Table-tops, etc.**

How are people trained to adequately meet these challenges?

- **Yes – via Containment Companies**
-

D) Gaps and Issues - Regulations, Standards, Practices, Collaboration, & Technologies

Regulations

a) Advanced Notification of Proposed Regulation & collaboration
b) Regulatory requirements focused on major hazards

Standards

a) Dispersant
b) Capping Stacks
c) NtL 10 submittals & planning docs

Technology

a) BOP control systems
b) Well integrity determination
c) Hydrate Control & Prevention
d) Open Water Capture Devices

Collaboration

a) Containment Company Cooperation
b) Incident Command Structure